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(54) Retractable antenna unit for a mobile phone

(57) A retractable antenna unit for a mobile phone comprises an antenna housing provided in the casing of the mobile phone, a helical antenna installed in the antenna housing, a whip antenna having an upper end provided with a knob and a lower end provided with a stopper, the stopper being also provided with a feeder part, and a metal tube for supplementing the length of the helical antenna when the whip antenna is completely retracted into the antenna housing, or serving to extend the physical effective length of the whip antenna when the whip antenna is completely pulled out from the antenna housing, whereby the wave feed position of the whip antenna is additionally raised when the whip antenna is completely pulled out from the antenna housing.

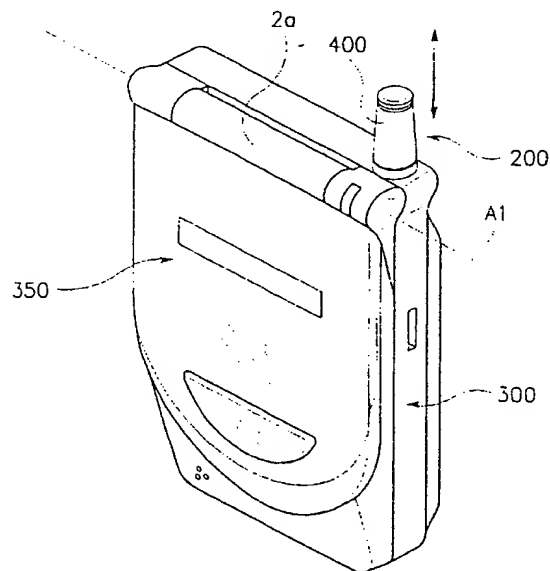


FIG. 1

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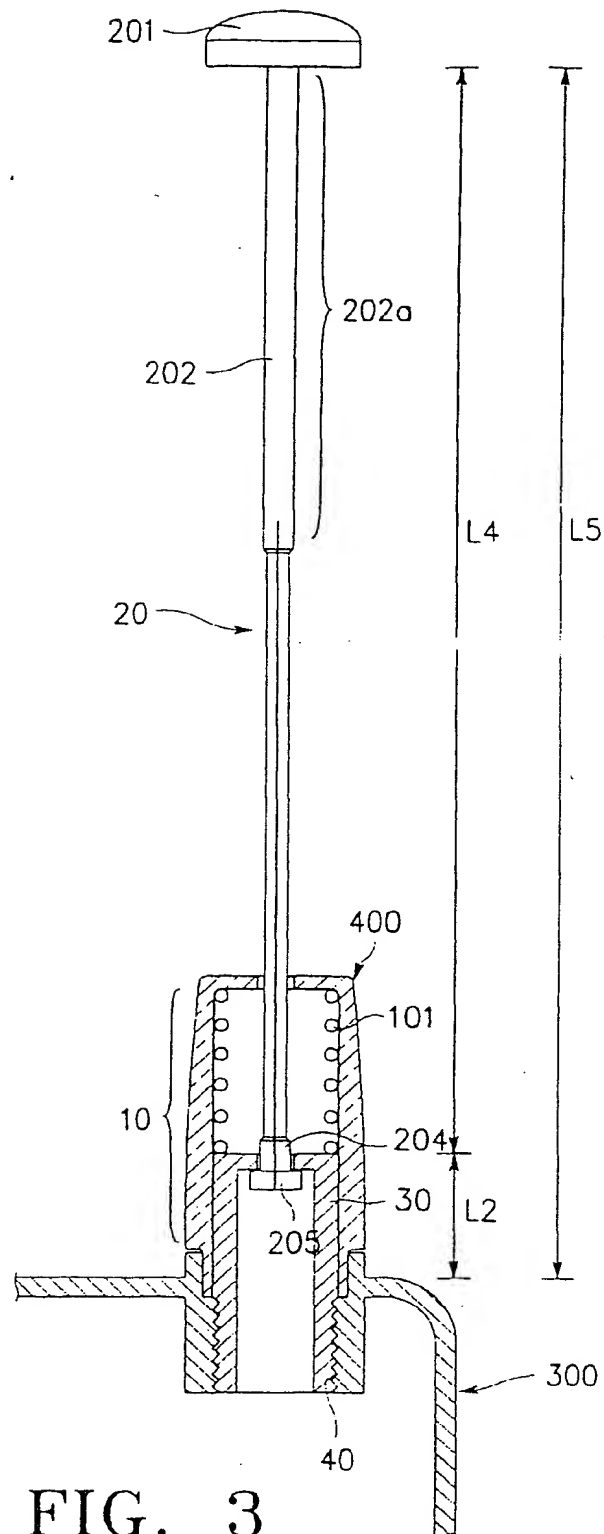


FIG. 3

Description

[0001] The present invention relates to a compact mobile phone, and more particularly a retractable antenna unit provided in such mobile phone operated in a low frequency band.

[0002] The mobile phone, such as cellular phone, and PCS phone is usually provided with a whip or helical antenna, whose length is generally designed to have $\lambda/4$ or $3\lambda/4$ of the operational frequency. If the whip antenna with such a length is permanently in the extended position, it would be inconvenient for the user to carry the mobile phone. On the other hand, the helical antenna has a short physical length, and hence is not so inconvenient, but its efficiency is low compared to the whip antenna because of the shorter physical length. Moreover, since the helical antenna shows more degraded performance in the talking position compared to the whip antenna, it is desirable to have an antenna with a relatively long physical length such as the whip antenna.

[0003] To this end, the retractable antenna has been developed uniting the whip and helical antennas to utilize the advantages of both types of antenna, which is well disclosed in U. S. Patent No. 5,479,178. Referring to this patent, when the mobile phone stands by to receive a call, the whip antenna may be retracted into the casing of the mobile phone, so that the helical antenna only performs its duty. However, communication being established, the whip antenna is completely pulled out from the casing to improve the communication quality. Hence, such a retractable antenna would be adequate if the body of the mobile phone is designed with sufficient length, so as to fully receive the whip antenna. However, as the size of the mobile phone tends to continuously decrease with the development of VLSI technology, the space where the whip antenna may be retracted in the casing of the mobile phone also diminishes. Further, retracting the whip antenna into the casing, it is required to electrically decouple it from the wave feeding point. However, if the space for receiving the whip antenna lacks, it is impossible to achieve complete decoupling. Consequently, this becomes one of the factors limiting the design of the antenna. For the whip antenna should be able to be retracted into the casing while the helical antenna is projected outside of the casing.

[0004] The object of the present invention to provide a compact mobile phone with a retractable antenna having an improved antenna system.

[0005] According to an aspect of the present invention, a retractable antenna unit for a mobile phone comprises an antenna housing provided in the casing of the mobile phone, a helical antenna installed in the antenna housing, a whip antenna having an upper end provided with a knob and a lower end provided with a stopper, the stopper being also provided with a feeder part, and a metal tube for supplementing the length of the helical antenna when the whip antenna is completely retracted

into the antenna housing, or serving to extend the physically effective length of the whip antenna when the whip antenna is completely pulled out from the antenna housing, whereby the wave feed position of the whip antenna is additionally raised when the whip antenna is completely pulled out from the antenna housing.

[0006] The present invention will now be described more specifically with reference to the drawings attached only by way of example.

Fig. 1 is a perspective view, illustrating a folder type mobile phone provided with the antenna unit;

Fig. 2 is a partial cross sectional view of a folder type mobile phone as shown in Fig. 1, illustrating the whip antenna retracted into the casing of the mobile phone;

Fig. 3 is a view similar to Fig. 2 but with the whip antenna completely pulled out from the casing; and

Fig. 4 is a perspective view, illustrating the retractable antenna unit provided with a metal tube.

[0007] The same reference numerals are used throughout the drawings to represent the same functional parts, and the detailed description of the parts not directly relating to the invention is omitted in order to prevent the technical concept of the invention from being misunderstood.

[0008] Fig. 1 shows a folder-type mobile phone, where the inventive antenna unit is applied. The inventive antenna unit is also applicable any other type of mobile phone. The casing of the folder-type mobile phone comprises a body 300, folder 350, and hinge mechanism for connecting the folder and body. The folder 350 may be opened from or closed to the body 300 pivoting about the central axis A1 of the hinge mechanism. The folder covers the key pad (not shown) consisting of alphanumeric and functional keys mounted on the top of the body 300 is an antenna unit 200. The microphone 312 is mounted below the key pad, and an ear piece (not shown) is mounted on the upper part of the folder 350 including the speaker. The LCD (not shown) is provided below the ear piece. The LCD displays the operational information including the data inputted through the key pad.

[0009] Describing the inventive antenna unit with reference to Figs. 2 and 3, a metal tube 30 is employed to supplement the physical length of the whip antenna, which is limited by the compact size of the mobile phone. The metal tube 30 serves to extend both the operational length of the helical part 101 of the helical antenna 10, when the whip antenna 20 is retracted into the casing (body) of the mobile phone, and the operational length of the whip antenna 20, when it is fully pulled out from the casing of the mobile phone. Namely, the helical antenna 10 is designed to consist of the helical part 101

and metal tube 30, so that the metal tube 30 may serve as the supplemental length of the whip antenna 20 when it is completely pulled out from the casing. Hence, the adjustment of the lengths of the helical part 101 and metal tube 30 may make the physical length of the whip antenna 30 conform to the desired size. This is especially advantageous for a compact size mobile phone operated in a low frequency band.

[0010] If the length of the whip antenna is made completely retractable into the casing of too small a mobile phone, it is impossible to secure 0.25λ for the effective antenna length especially in low frequency band CDMA and GSM. This may be resolved by substituting the metal tube 30 for a part of the helical antenna so that the metal tube 30 serves as the supplemental part of both the helical antenna 10 and whip antenna 20 to make their size 0.25λ . Thus, the antenna comes to have sufficient radiation capability. Referring to Fig. 2, when the whip antenna 20 is completely retracted into the casing, the helical antenna 10 consisting of the helical part 101 and metal tube 30 serves as the effective antenna.

[0011] The metal tube 30 is integrally formed with a threaded antenna fitting 40, inserted into an antenna housing 400, which is mounted on the body 300 of the mobile phone by means of the antenna fitting 40. The whip antenna has a knob 201 with a rod 202 which must be insulated to a length sufficient to prevent coupling action with the antenna fitting 40 and helical part 101. When completely retracted, the rod 202 is positioned throughout the helical part 101, metal tube 30 and antenna fitting 40. Referring to Fig. 2, reference symbol L1 represents the physically operational length of the helical part 101, and L2 the physical length of the metal tube 30, so that the total physically operational length L3 of the helical antenna 10 is $L1+L2$ when the whip antenna 20 is completely retracted into the casing.

[0012] Referring to Fig. 3, fully pulled out from the casing, the whip antenna 20 has the stopper 205 contacting the upper end of the metal tube 30, so that its effective length is supplemented by the length L2 of the metal tube 30. L2 represents the length of the metal tube projecting from the casing, and L4 the physical length of the whip antenna 20, so that the total effective length L5 of the whip antenna 20 is $L2+L4$. Therefore, completely pulled out from the casing, the whip antenna 20 comes to have the effective length of L5.

[0013] Thus, the metal tube 30 is commonly used by the helical antenna 10 and whip antenna 20. In the retracted position, the metal tube 30 is used by the helical antenna 10 and in the extended position the metal tube 30 is used by the whip antenna 20.

[0014] Fig. 4 illustrates the structure of the antenna unit in more detail. The whip antenna 20 is designed to be retracted into or pulled out from the casing while the helical antenna 10 is fixedly installed in the antenna housing. The whip antenna 20 has an antenna knob 201 at the upper end, and the stopper 205 at the lower end. The stopper 205 is provided with a first wave feeding

metal 204. The metal tube 30 and antenna fitting 40 serve as a second wave feeding metal corresponding to the first wave feeding metal 204. The upper end 301 of the metal tube 30 is partly opened while the lower end is fully opened (not shown). The whip antenna 20 may be retracted or pulled out through the cylindrical space of the second wave feeding metal. When the whip antenna is fully pulled out from the casing, the first wave feeding metal 204 contacts the upper end of the metal tube 30. On the other hand, when fully retracted into the casing, the rod 202 of the whip antenna 20 is positioned throughout the inside of the helical antenna 10 and second wave feeding metal 30 and 40. Additionally, the upper end 101a of the helical part 101 may be bent to reduce the space between the surface of the whip antenna 20 and the helical part 101, and thus to improve the coupling action between the whip antenna and the helical part 101, when the helical part 101 has a large diameter. Thus, the invention substitutes a metal tube for a part of the helical antenna to supplement the physical length of the whip antenna for a compact mobile phone operated in a low frequency band.

[0015] While the present invention has been described in connection with specific embodiments accompanied by the attached drawings, it will be readily apparent to those skilled in the art that various changes and modifications may be made thereto.

Claims

1. A retractable antenna unit for a mobile phone, comprising:

an antenna housing (400) provided in the casing of said mobile phone;

a helical antenna (10) installed in said antenna housing (400);

further characterized by

a whip antenna (20) having an upper end and a lower end, said lower end being provided with a stopper (205), which is provided with a feeder part (204).

2. The retractable antenna as defined in claim 1, further comprising

a metal tube (30) for supplementing the length of said helical antenna (10) when said whip antenna (20) is completely retracted into said antenna housing (400), or serving to extend the physically effective length of said whip antenna when said whip antenna is completely pulled out from said antenna housing (400), whereby the wave feed position of said whip antenna is additionally raised when said whip antenna is completely pulled out from said antenna housing (400).

3. The retractable antenna according to claim 1 or 2, wherein said upper end is provided with a knob (201).
4. The retractable antenna as defined in any of Claims 1 to 3, wherein said metal tube (30) has the lower end provided with a conductive threaded antenna fitting (40) for fixing said metal tube (40) into said casing. 5
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5. The retractable antenna as defined in Claim 4, wherein said conductive threaded antenna fitting (40) is integrally formed with said metal tube (30).
6. The retractable antenna as defined in any of Claims 1 to 5, wherein said helical antenna (10) is installed between said antenna housing (400) and metal tube (30) with its lower end closely contacting the upper end of said metal tube (30). 15
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7. The retractable antenna as defined in any of Claims 1 to 6, wherein the upper end of said helical antenna (10) is bent so as to improve the coupling effect between said helical antenna (10) and whip antenna (20). 25

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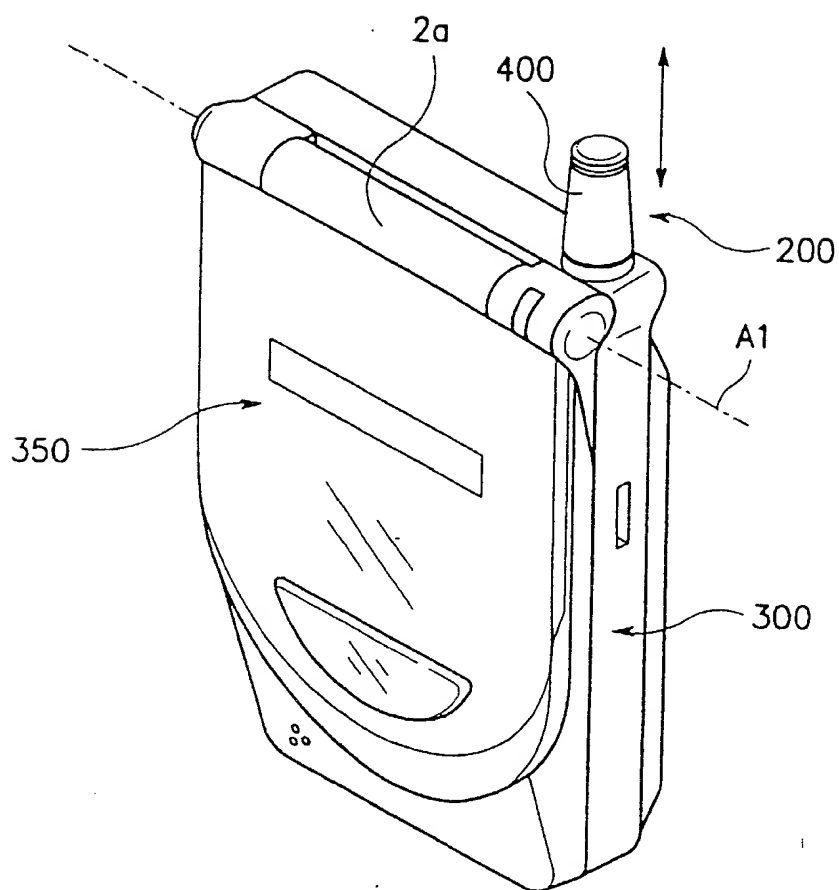


FIG. 1

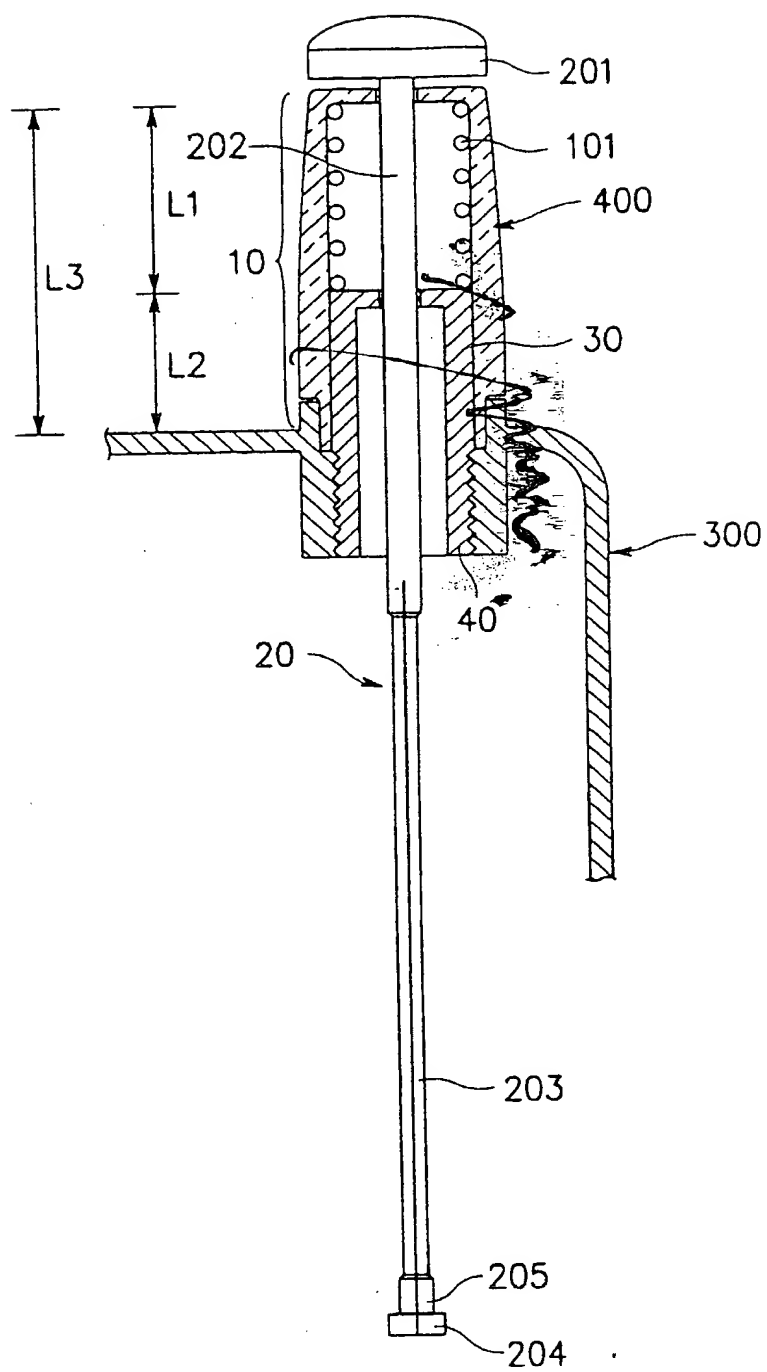


FIG. 2

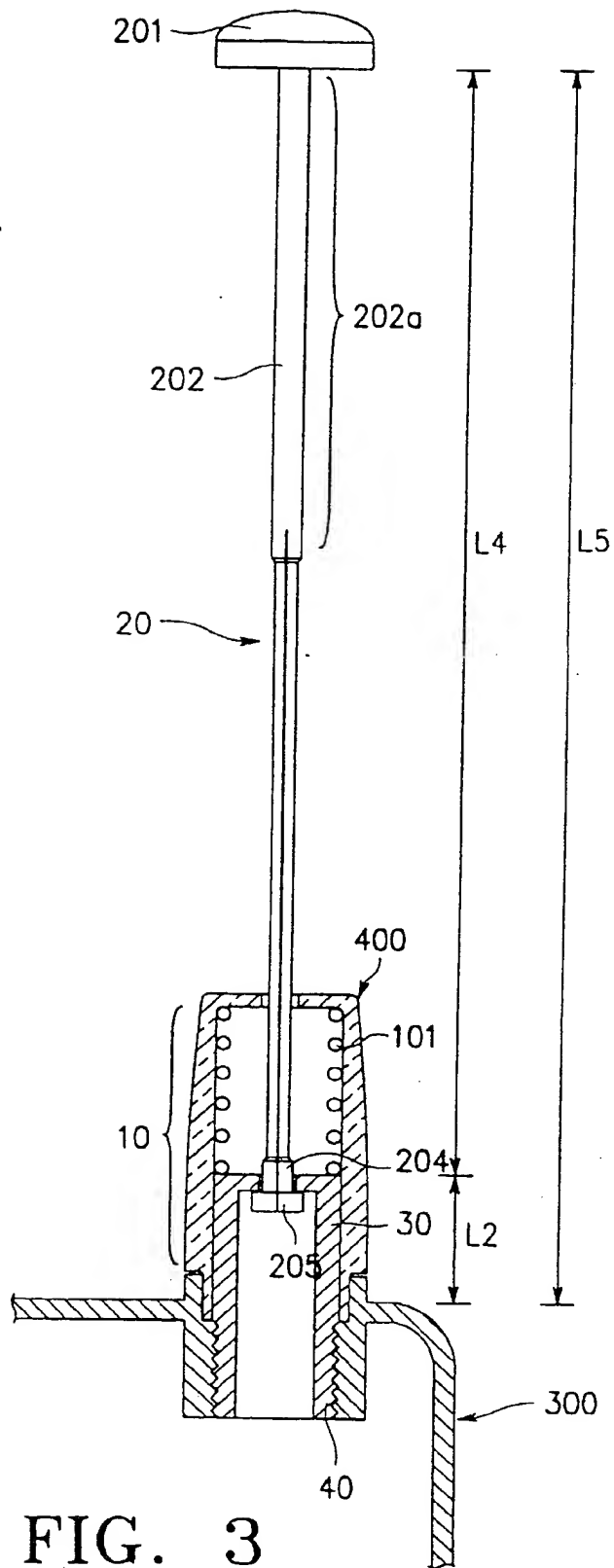


FIG. 3

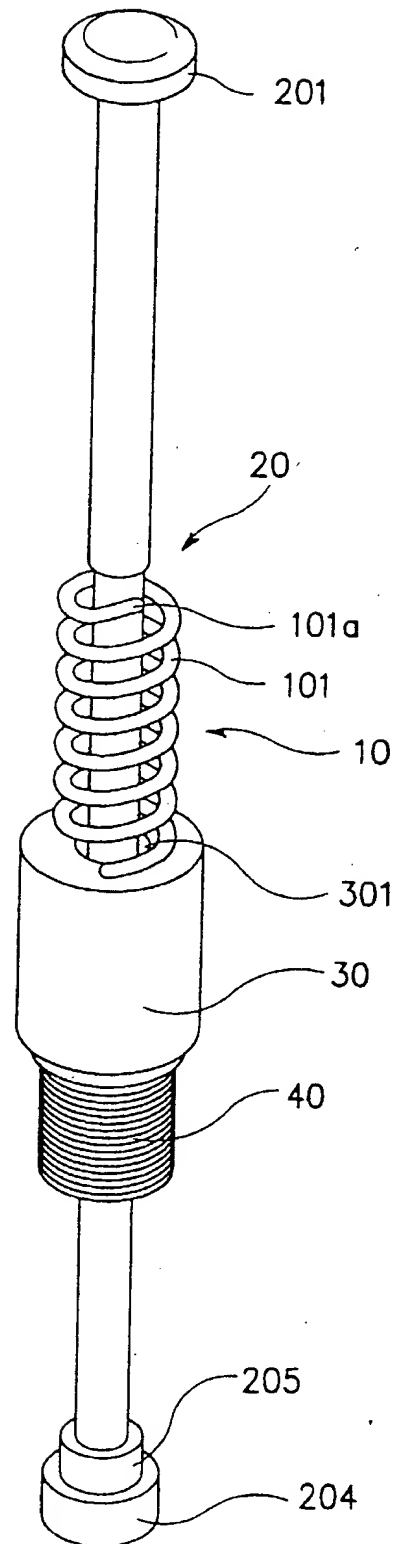


FIG. 4



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EUROPEAN SEARCH REPORT

Application Number
EP 99 12 1260

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X	EP 0 716 469 A (SONY) 12 June 1996 (1996-06-12)	1,3-6	H01Q1/24
Y	* column 5, line 22 - column 6, line 4; figures 3-36 *	7	
X	WO 97 02622 A (SMK) 23 January 1997 (1997-01-23) * abstract * * page 11, line 3 - page 19, line 19; figures 1-4,8,9 *	1,3-6	
Y	WO 97 23014 A (CENTURION) 26 June 1997 (1997-06-26) * page 6, line 33 - page 7, line 7; figures 2-4 *	7	
A	US 5 825 330 A (NA ET AL.) 20 October 1998 (1998-10-20) * column 4, line 15 - line 45; figure 28 *	2	
P,A	WO 99 43042 A (SAMSUNG ELECTRONICS) 26 August 1999 (1999-08-26) * abstract; figures 2,3 *	1-7	TECHNICAL FIELDS SEARCHED (Int.Cl.7) H01Q
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 16 February 2000	Examiner Angrabeit, F
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 99 12 1260

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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